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ARTICLE

Central issues in the use of computer-based materials for high volume entrepreneurship education

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ABSTRACT This article discusses issues relating to the use of computer-based learning (CBL) materials for entrepreneurship education at university level. It considers CBL as a means of addressing the increased volume and range of provision required in the current context. The issues raised in this article have importance for all forms of computer-based learning and also have relevance for emerging technologies in the field. Based on evidence reported in this article, it is argued that, while there is potential for gaining economies of scale by using CBL materials for entrepreneurship education, there are also potential trade offs and conflicts of interest involved in such approaches. The findings also point to the importance of the student perspective for the design and use of CBL materials for high volume entrepreneurship education.
KEYWORDS: *computer-based learning, entrepreneurship education, large classes, university education*

Introduction

This article addresses the use of CBL material for entrepreneurship education and offers an analysis of the perceived impact of multimedia. A comparison is made regarding the perceived impact of on-screen text CBL material and multimedia CBL material.

Perspectives vary on defining entrepreneurship (Thompson, 1999), and on how best to provide entrepreneurship education and for whom this should

be done (Gibb, 2004; Hills, 2004; Kirby, 2004). There are also differing views regarding evaluation of entrepreneurship education, with some advocating a focus on cost benefits or opportunity costs for the providers (Westhead, 1999). The issues involved in entrepreneurship education increase in range and complexity when the classes are large and heterogeneous. Changes in policy have led to increasing numbers and range of students in higher education (Whiteley, 1995). Computer-based learning approaches are used as a means of accommodating these changes. However, it is important that multiple perspectives are considered by providers involved in developing and/or using CBL for entrepreneurship education, as highlighted in this article.

With recognition of entrepreneurship as an academic discipline (Sandercock, 2004) there comes an increased range of responsibility. Entrepreneurship departments have to cater appropriately for the full range of students now in higher education. It has long been argued that the more interactive the approach offered to learners, the more they are likely to benefit. Where staff numbers are limited there are operational difficulties faced, which may have a negative impact on the level of interactivity offered. There is often a focus on cost/benefits or opportunity costs for the providers of entrepreneurship education (Henry et al., 2004; Henry et al., 2005). Such a limited focus may fail to take student needs and wants into account and may result in opportunity costs being incurred. This may be addressed up to a point within a lecture environment (Huxham, 2005), but it may be argued that CBL offers greater potential.

It is now largely accepted that computer-based materials may be used at various levels to facilitate learning. This approach is being adopted for large classes in entrepreneurship education. The literature relating to perceived impact of computer-based materials reflects a range of perspectives. Differing views may be found regarding CBL design and use (Robinson et al., 1998). Central issues regarding the development and use of CBL material include cost effectiveness (Russell, 1999) and meeting of learner needs (Reigeluth, 1999). Where we seek to 'satisfy' users, the meeting of 'customer' expectations is highlighted as important (Hobbs and Boucher 1997). The viewpoint of the 'learner–customer' in higher education is therefore of particular significance in the current climate. This article proposes that in order to use CBL materials appropriately to address the student volume issue and also treat the students as customers, a holistic approach to the design and use of CBL materials is required.

Perspectives on learning have moved from response strengthening to knowledge acquisition, to knowledge construction. The associated practices of education providers have in turn progressed from drill and practice to transfer of information and to meaningful interaction involving active learning (Mayer, 1999). Understanding of topics is better facilitated when the

'core notions' are represented in more than one way (Gardner, 1999). Learning by doing is particularly important where skills are to be learned and having a realistic context with easily accessed information and situated relevant feedback offers students the most appropriate opportunity to learn (Schank et al., 1999). Use of simplified versions of an overall experience is considered to motivate learners (Reigeluth, 1999). CBL may be argued to provide a means of offering all of these potential benefits for learners. Learner engagement may be argued to be centrally important in relation to CBL (Stoney and Oliver, 1997). Multimedia within CBL materials may be argued to offer potential for motivating learners (Whitelegg et al., 1997) and to facilitate constructivist approaches to learning (Laurillard, 1993). To cater for intrinsically motivated learners, CBL materials might be expected to present tasks designed to be meaningful, at an appropriate level of difficulty, allow for multiple levels of coding, and require the learner to be cognitively active. However, externally motivated learners may need more direct reinforcement. This suggests that a wide range of options should be made available in CBL material designed for a heterogeneous cohort of learners. While there are many variations and permutations available as CBL material, there are essentially four major categories within which such variations may be found (see Table 1).

CBL material may range from digitized lecture notes to complex game software. It may be argued that any of these approaches make use of the 'new technologies' and offer learners greater levels of freedom to learn (see Tables 1 and 2). However, the level at which given approaches make

Table 1 **Overview of CBL elements**

	Computer-based learning material: presentation format			
	Lecture notes	*Electronic book software*	*Simulation software*	*Game software*
Element used				
Text	Basic requirement	Basic requirement	Optional	Optional
Hypertext	NA (generally)	Basic requirement	Optional	Optional
2D graphics	Optional	Optional	Basic requirement	Optional
3D graphics	NA (generally)	Optional	Optional	Optional
Animation	NA (generally)	NA (generally)	Optional	Optional
Video	NA (generally)	NA (generally)	Optional	Optional
Sound	NA (generally)	NA (generally)	Optional	Optional
Exercises	Optional	Optional	Optional	Optional
Interactivity	NA (generally)	Optional	Optional	Basic requirement

Table 2 **Overview of CBL benefits**

	Computer-based learning material: presentation format			
	Lecture notes	*Electronic book software*	*Simulation software*	*Game software*
Potential benefits				
Economies of scale	Yes generally	Subject to development costs	Subject to development costs	Subject to development costs
Learner control over pace of learning	Yes generally	Yes generally	Yes generally	Yes generally
Learner control over time of learning	Yes generally	Yes generally	Yes generally	Yes generally
Learner control over direction of learning	No generally	Yes subject to navigation options available	Yes subject to navigation options available	Yes subject to navigation options available

best use of the digital medium is still open to debate. The lecture notes model may be criticized on the basis that it fails to adjust the style of presentation to suit the digital medium. Electronic books may be argued to be ahead of digital lecture notes in that more flexibility is offered to the learner regarding navigation of the material, the screen presentation has been designed to suit the medium in use and the use of hypertext makes the learning experience 'interactive'. Simulation and game software generally involves a higher level of complexity than the options previously discussed and may be used as the overarching context, or a sub-set within the CBL materials. In financial terms the cost of development, production and use increases as the material increases in complexity, with lecture notes tending to be relatively low cost and complex games high cost. Within all of these formats there is an underlying control exerted by the authors and developers of such material, therefore the degree of learner freedom is likely to vary depending on the parameters in use by such decision makers.

Given that relatively basic CBL offers learners personal control over time, pace, place and direction of learning, the value of more sophisticated CBL material, which is more expensive to develop and produce, or purchase, requires careful analysis. We might conclude that if the educational results are similar then the less expensive option should be chosen. However, there are related issues to be considered which take us beyond financial outlay and test results.

The selection of activities, involving intrinsic or extrinsic reward is centrally important in achieving learner satisfaction and this requires judgement on the part of the instructional designers (Reiser and Dempsey, 2002). Where this level of design input is considered an unnecessary expense there is a potential opportunity cost for learners, as the more basic CBL formats tend to involve less freedom of choice for the learners. This article argues that the most likely means of meeting the needs and wants of a heterogeneous group of student 'customers' is to maximize the freedom of choice offered in the CBL materials used. Failing to meet student needs and wants could be potentially costly for an education provider. Provider approaches may range from the seeking of continuous improvement in meeting the needs of students to the seeking of economies of scale. Where economies of scale are the paramount concern, the underlying motivation may be argued to be less than ideal (Ehrmann, 1995). Where providers claim the meeting of student needs and wants to be centrally important, it may be argued that both cognitive and affective domains should be taken into account. This would require that many aspects of CBL design be taken into account in order to align the 'theory in practice' with the 'theory in use'. Therefore it is important to find out what such needs and wants may be regarding any CBL material offered.

This article addresses the importance of the student perspective concerning CBL materials used to cater for large entrepreneurship education classes at university level. Expressed student perceptions of the material and their preferences are highlighted, as is the importance of reflecting on proclaimed values regarding provision offered. This is argued to be important in order to minimize any mismatches. This article highlights the danger that a less detailed scrutiny is likely to result in important design elements being disregarded in favour of more basic and less expensive alternatives. Two different kinds of research are reported on in this article, one taking a quantitative approach to investigate the comparison of on-screen text and multimedia presentation and the other seeking qualitative feedback from interviews regarding the topic.

Although the case for considering students as consumers and the need for learner centred approaches has been strongly made, there has been little in-depth research on the student perspective regarding the instructional and interface design of CBL materials. This research seeks to address this by eliciting the views of students using CBL material within higher education and business regarding the design of a range of CBL material currently in use. Given that this research used a case study approach, the issue of generalizability is open to some debate; however, it may be considered that the issues revealed by the research are likely to be generally of interest to those in the higher or tertiary education field. Given the nature of this research, validity was addressed by having the subjects validate material where possible,

using interview maps. It was considered that real subjects, using real material, for real learning, satisfied the 'truth value' of the data obtained.

The research conducted

The students involved in the two investigations reported in this research were drawn from a range of year groups and core faculties. All concerned had self-selected the elective class in entrepreneurship and had voluntarily participated in the research conducted. Numbers in the class studied in this research averaged around 200 students registered per academic year.

Investigation 1: a comparative investigation of on-screen text versus 'multimedia'

The question investigated here was whether students would have a preference regarding the on-screen presentation of CBL material using on-screen text, or using multimedia. This research compares the use of on-screen text CBL material for entrepreneurship education with CBL material which presents the same learning content via a wider range of on-screen presentation, utilizing graphics and closed loop exercises, therefore termed multimedia. Statistically significant results, obtained from a comparative study (N=65), are presented as evidence of the extent and direction of the preferences expressed by the students concerned. This investigation made use of a sub-set of the material from the Introduction to Business Start-Up class. The material consisted of an on-screen exercise, and a webpage showing the same content in a text-based format. The multimedia version of the exercise made use of on-screen graphics and user operated on-screen buttons. The text-based version offered a text-based description of the setting followed by a text based version of the exercise script. Each version asked questions in a text-based format.

The assumptions made were that the student responses would be genuine and that feedback relating to the subset of the overall coursework material could be generalized to the rest of the CBL material concerned. The hypothesis regarding the mode of presentation was that there would be a difference in the expressed preferences for the on-screen text version and the on-screen exercise version of the material. Given that the hypothesis was open to the potential effect being in either direction, the significance value was treated as 'two tailed'.

Method

The samples were based on convenience, to the extent that only those who attended and agreed to participate were included in the data collection exercise. Data was gathered from 65 students by means of questionnaires

Table 3 **Numbers of respondents using each version of questionnaire**

Questionnaire version	*Frequency*	*Percent*
A: Full exercise version followed by web-based text version	34	52.3
B: Web-based text version followed by full exercise version	31	47.7
Total	65	100.0

administered during an entrepreneurship elective class. The students were requested to take part by following the instructions provided and completing the associated questionnaire. The instruction sheets and questionnaires were counterbalanced with respect to the order in which the students accessed the two versions of the material (see Table 3) and the investigation was carried out with minimal tutor involvement. It was considered that non-parametric tests were appropriate given the data involved. No order effect was identified (Mann-Whitney U Test, Z Score −1.944, Sig. [2-tailed] 0.05).

Results

A Wilcoxon Signed Ranks Test was run on the mean scores obtained by each of the questionnaire items under each condition (A: exercise version on screen, B: text version on screen). The result obtained from the Wilcoxon Test (Z Score −6.417) indicates that statistically significant differences exist (at 0.000 level) between the means concerned.

The results indicate a significant difference in student preference relating to the style of presentation of the material. Specifically, the results indicate that more positive ratings were obtained in relation to the on-screen exercise version of the material, with lower, more negative ratings being obtained in relation to the on-screen text version of the material. The results show higher perceived levels of challenge, interest, engagement, motivation and learning for the multimedia material having statistical significance at the 0.000 level (see Table 4).

The results support the conclusion that the multimedia presentation of the CBL material concerned offers greater value for entrepreneurship students than an on-screen text presentation of the same material. Therefore it should be used where possible in preference to on-screen text.

Investigation 2: an interview-based investigation of underlying reasons for expressed preferences

Again, the question investigated here was whether students would have a preference regarding the on-screen presentation of CBL material using on-screen text, or using multimedia. This research investigates the underlying

Table 4 **Examples of statistically significant results obtained by questionnaire item**

Wilcoxon Signed Ranks Test results summary by questionnaire item questions relating to computer-based exercise/scenario material (N of items = 64)	*Z score*	*Sig-level (2-tailed)*
The computer-based on-screen text/on-screen exercise version of this material offered me a challenge	−4.820	0.000
I found the tasks set in the computer-based on-screen text/on-screen exercise version of this material interesting	−4.766	0.000
The computer-based on-screen text/on-screen exercise version of this material inspired me to think about the material I had previously covered	−4.484	0.000
The computer-based feedback from the on-screen text/on-screen exercise version of this material helped me check that I was really learning	−4.753	0.000
I felt as though I was actively learning from this computer-based on-screen text/on-screen exercise version of this material	−5.107	0.000
The look of the screen displays in this computer-based on-screen text/on-screen exercise version of this material helped motivate me	−4.928	0.000
I found this computer-based on-screen text/on-screen exercise version of this material allowed me to practise doing the things I needed to do	−4.497	0.000
I found the on-screen feedback in this computer-based on-screen text/on-screen exercise version of this material made me actively think about my decisions	−5.146	0.000

reasons for entrepreneurship students' expressed preferences regarding the CBL material used. Response frequencies are quoted for student comments made during interviews (N = 61) and the qualitative feedback obtained is considered to reflect the underlying thinking of the students concerned and to offer clarification of the reasons for their expressed preferences.

Interviewing was considered particularly appropriate for this element of the research as it provided the opportunity to gain a deeper understanding of the meanings interviewees attached to the issues raised. It was considered that a completely non-directive approach would fail to produce the level of feedback sought, therefore a semi-structured design was used. The intention was to elicit feedback that would clarify the aspects of importance for the interviewees and clarify the reasons for the level of importance attached to CBL elements from a learner perspective.

Method

The interview responses were individually mapped in order to show perceived causal connections for the individual interviewees (see Figure 1).

The approach taken in this research enabled constructs to be made explicit and the data obtained was based specifically on the particular individual's framework. Two interviews were conducted with each subject where possible (see Table 5), in order to gain further comment and to further validate the mapped representation of the interviews concerned.

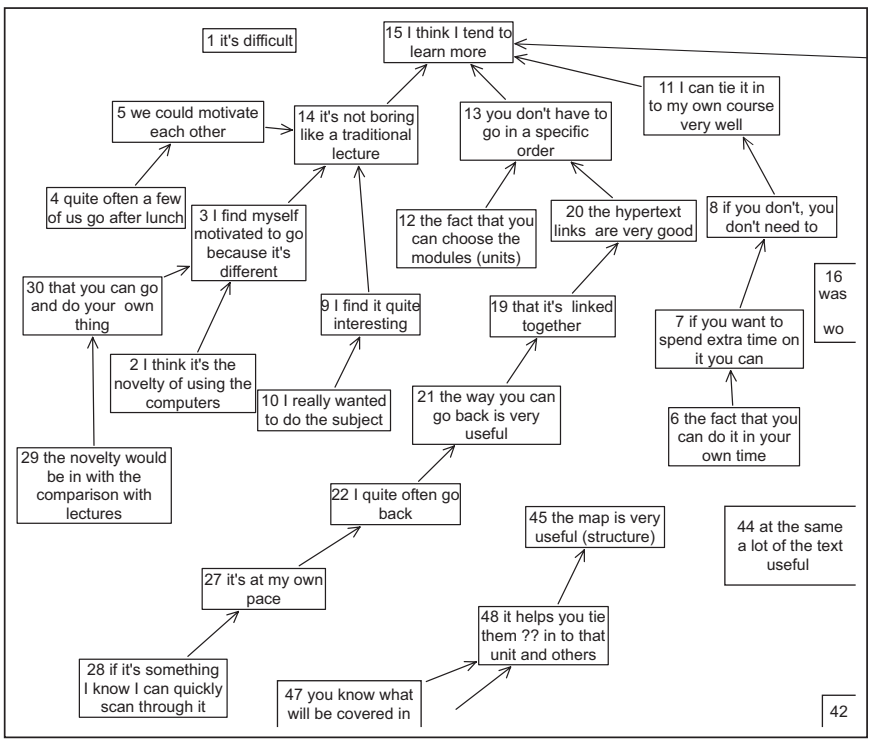

Figure 1 **Example of mapped interview**

Table 5 **Participants by interviews 1 and 2**

Interviewees for interview 1	*Interviewees for interview 2*
1–16	1
17–34	17, 18, 19, 20, 23, 24, 25, 27, 28, 29, 32, 33, 34
35–45	35, 36, 37, 38, 40, 41, 42, 45
46–53	46, 50
54–61	54, 56

No statement was made regarding the interviewer's personal viewpoint and all answers provided by the subjects concerned were treated as being equally accepted.

Results

The interview feedback was categorized using emergent categories from the student statements in order to offer some level of quantitative detail regarding relative positions (see Figures 2 to 8). The qualitative statements made in interviews provide evidence of the importance of the issues raised from the perspective of the interviewees.

Perceived impact of usability and navigation

Ease of use is highlighted as a centrally important issue (72%). Multiple pathways or linkages through the material require clear signposting, as hyperlinks were perceived as confusing (51%), but variation is evident in learner preferences regarding pathways and signposts (map-aided navigation received 41% positive comment but 7% negative comment). Reading text from the screen resulted in some learners experiencing fatigue and eye strain (26%) and in some cases headaches were reported following the two hour sessions concerned (see Figure 2). The interview comments made suggest that there are benefits to allowing students to set options as they desire regarding navigation. Learner expectation is highlighted as important in terms of motivation. Where new windows were accessed this tended to raise expectations of new material. Where this was so, students were motivated. Expectations were reduced when the same material was accessed via a number of links, giving rise to a level of annoyance, which resulted in students ceasing to use such links.

Perceived impact of graphics/multimedia elements

The use of graphics is shown to have added interest (44%) and even a level of enjoyment, or entertainment. The graphics were considered to break up

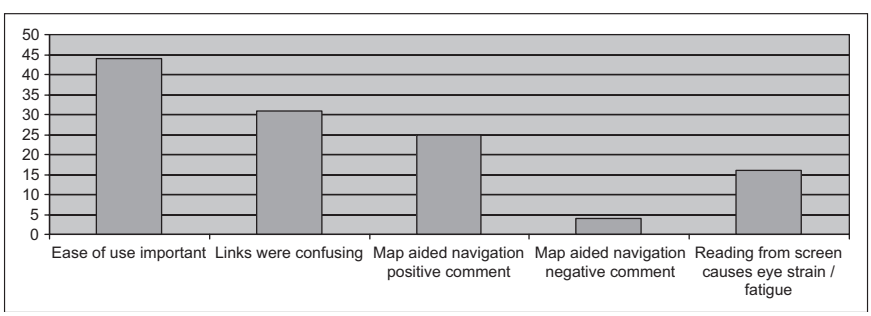

Figure 2 **Interview response frequencies (N = 61)**

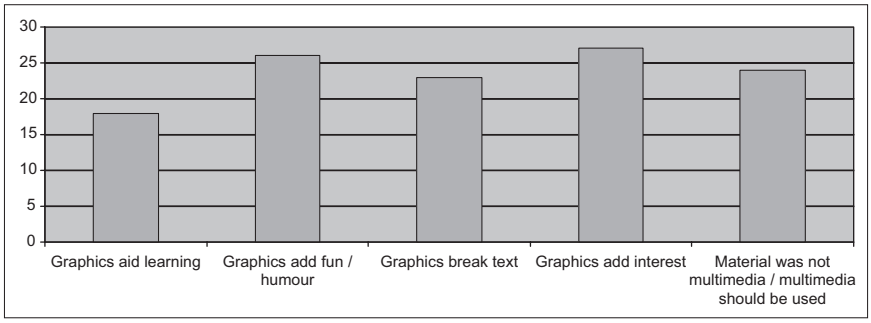

Figure 3 **Interview response frequencies (N = 61)**

the monotony of the text windows (38%) and help learners relax and feel happier. This was perceived to maintain learner motivation and make learning easier to achieve. Humour was highlighted in relation to the graphics (43%) and they were considered to aid learning (30%). The feedback indicates that learners' expectations of multimedia were not entirely met by the material (39%).

Perceived impact of exercises

Exercises were perceived to have aided learning (59%) and to have added and maintained interest for learners (57%), even to the extent of being entertaining. They were also considered to have provoked learners to think (62%). The avoidance of frustration is highlighted as important and the achievement of improvement over multiple attempts is highlighted as important in this regard. It is also highlighted that exercises should be easy to use, offer a degree of challenge and should also be fun. The interview feedback suggests the need for a range of difficulty in the exercises offered, as learners vary in their preferences regarding the complexity desired in exercises (see Figure 4 where 'Make exercises more complex' received 33%, while 'Less complex' received just 5%). Feedback provided in the exercises is highlighted as important, but again there is variation in preference regarding exercise feedback, which suggests a need for learner choice options regarding the nature and speed of feedback available.

Perceived impact of on-screen text

Breaks in the text are highlighted as important (66%) and too much text is perceived to become boring for learners (46%). Where long sections of text are used this can result in learners skimming the material. Where learners are faced with too much text they are likely to lose interest in, or concentration on the material. Where substantial reading is involved there is an expressed preference for printed material rather than on-screen text (33%).

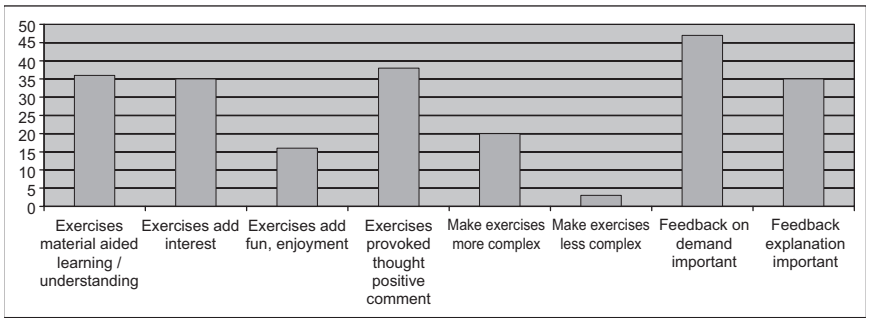

Figure 4 **Interview response frequencies (N = 61)**

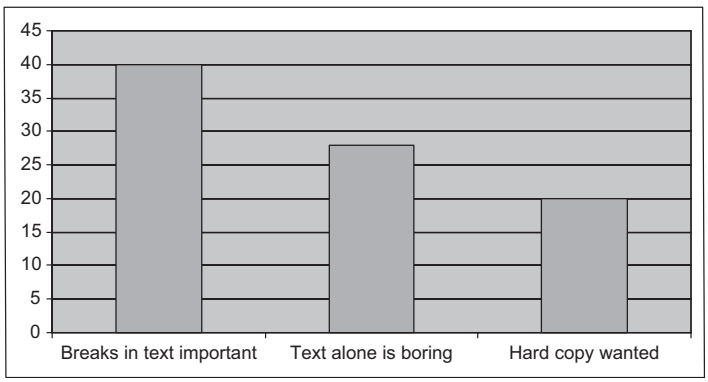

Figure 5 **Interview response frequencies (N = 61)**

The interview comments reveal a preference for a quiet atmosphere where reading has to be undertaken. The underlying reasons for the desire for printed material range from reducing eye strain and fatigue to ease of use. Having printed material is considered to allow learners to refer to such at a later date, to have copies that they may annotate, or to read as they travel.

Perceived impact on learning/understanding

Regarding material content, the interview feedback highlights the importance of perceived relevance (87%). Real life examples in the material were considered important (41%). Being able to relate the material to 'normal people' and being able to apply the material to the real world was perceived to increase understanding of the material concerned. Interactivity was considered important (46%). It was perceived as 'learning by doing' and was considered to have a positive impact on learner attention. There is variation demonstrated in the perceived definitions of 'interactivity', from the act of choosing in problem solving exercises to the simple act of clicking on-screen

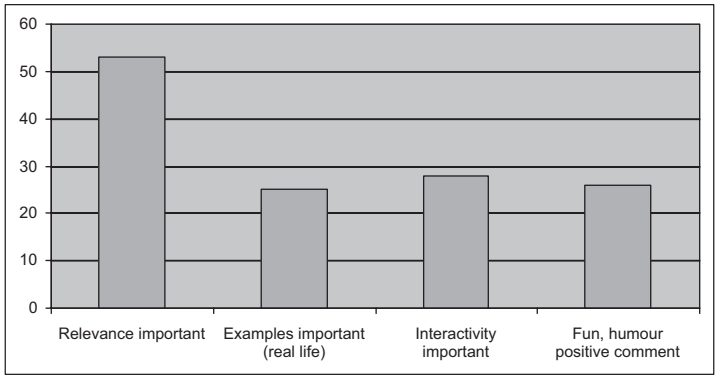

Figure 6 **Interview response frequencies (N = 61)**

buttons, each being perceived as 'interactive'. Humour within the material was considered motivating and helpful for student learning (43%).

Perceived impact of choice element

Learner motivation is considered to be increased by the personal freedom offered in time of learning (67%), pace of learning (51%) and the route taken through the material (66%) being choices for the students. The importance of personal freedom in self management of learning is clearly highlighted as important (87%). The lack of location flexibility (access issues) was perceived as a negative aspect of the CBL material (46%).

Comparative comment

The CBL material was considered better than lectures (56%), as it was perceived to be more personal than lectures, offered the individual student direct feedback and was always there whenever they wanted to access the material. However, it was also suggested that there was a potential problem with this, in that the learner may fail to take note of the important points therein.

It is clear from the interview feedback that students do not wish all classes to be available via CBL (15%). However, there is considerable variation regarding the best mix of direct contact and CBL. There is also variation regarding the level to which forced compliance should be used as a means of ensuring student participation. Timetabling is highlighted as an issue with computer-based options being regarded as a possible means of addressing such. While a 'chatroom' option was potentially acceptable, having contact with real people was considered preferable. The importance of being able to see and hear the other party involved in any tutorial communication is highlighted in the feedback obtained.

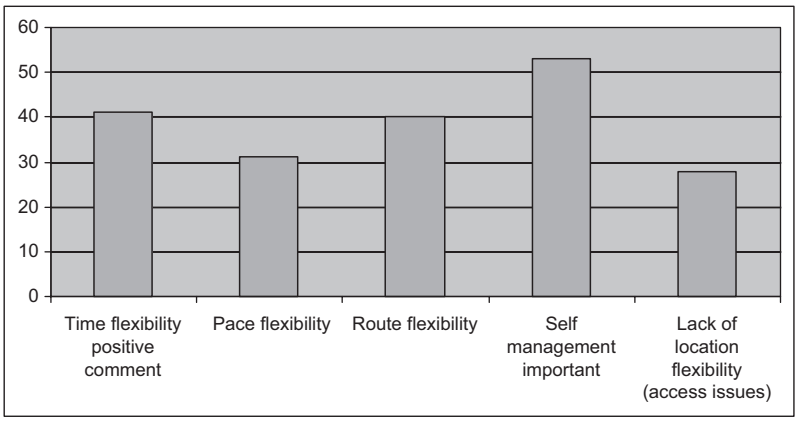

Figure 7 **Interview response frequencies (N = 61)**

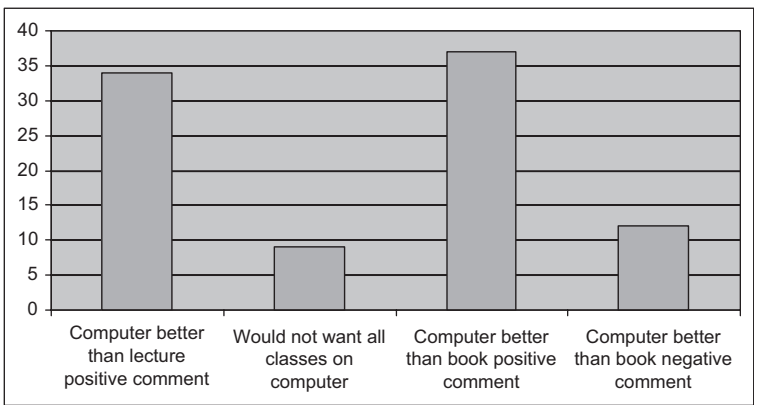

Figure 8 **Interview response frequencies (N = 61)**

The CBL material was perceived to be preferable to a book (61%). Mixed views were expressed regarding comparison with a book, with the most notable points being that CBL material did not seem as big a task as reading a book, which made it easier to concentrate on the CBL material than a book or lecture. The conversational style of the CBL material with the light humour element, the exercises and the ease of finding information were elements which were perceived to make the material better than a book. The use of colour and graphics was also considered to make the CBL material less boring than a book. Books were perceived as providing background information, with nothing to look forward to but text, and nothing to do but turn pages. However, books were also perceived to make it easier to go back through the material, rather than having to go back to the computer lab, as the book was portable. Students indicated that they were

used to reading books and their eyes did not get so tired with books, therefore they preferred books to the CBL material (20%).

Conclusions and recommendations

The results obtained in this research suggest an alternative to the 'no significant difference' analysis (Russell, 1999) and highlight the importance of the users' perspective. The results lend support to those who argue for the importance of meeting learner needs (Reigeluth, 1999) and 'customer' expectations (Hobbs and Boucher, 1997). The results also support the case for the importance of achieving learner engagement with CBL (Stoney and Oliver, 1997) and the potentially positive motivational value of multimedia within CBL (Whitelegg et al., 1997).

The results show that CBL materials can be used to address issues involved in dealing with large class sizes in entrepreneurship education. However, they also suggest that CBL should not be regarded as an easy option, nor as a means of saving money in the short to medium term, on account of the likely complexity involved in meeting the needs and wants of sizeable heterogeneous groups. The results suggest that where any CBL material is offered to large numbers of students it is likely to require a level of design specification which offers a wide range of student choice, given that we seek to meet their needs and wants or expectations. Student choice options would be relevant at the levels of interface design and instructional design as well as at the level of multimedia and interactivity selected. In short, if we truly wish to cater for our 'customers' there is a clear need to take this on board from the design stage right through to production and use. The holistic perspective should not be sacrificed in favour of more easily measured sub-set perspectives.

This research suggests a number of recommendations for those involved in making design decisions relating to CBL materials for entrepreneurship education within universities:

- Personal freedom in managing learning should be maximized for learners.
- Navigational choice should be made available to students allowing them to set the level of complexity and their preferred navigational options in the material.
- Graphics should be included.
- Humour should be included.
- Exercises should be included which are easy and fun to use, offer a degree of challenge and a range of difficulty which is a learner choice option.
- Feedback should be offered for all exercises with levels of feedback ranging from simple to complex and immediate to delayed and this should be a learner choice option.

- The level of text on-screen should be kept to a minimum, with additional on-screen text available as a learner choice option.
- Where a substantial volume of text is presented on-screen there should be a print option available to learners.
- The material should specify the potential relevance of content for learners and should make use of real life examples.
- Any potential for 'violation of expectancy' should be minimized or avoided by assessing and meeting, or setting learner expectations from the outset and throughout the material (e.g. interactivity level/use of multimedia).

The results of this research have importance for any computer-based learning material. It is largely irrelevant whether the delivery involves use of a CD ROM, hard drive based software, server-based network-distributed, or globally distributed software via Internet connectivity. While there are technical issues of difference, the learning issues remain relevant and worthy of further research, as illustrated by the many on-going debates at current conferences and seminars regarding teaching, learning and the use of educational technology.

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